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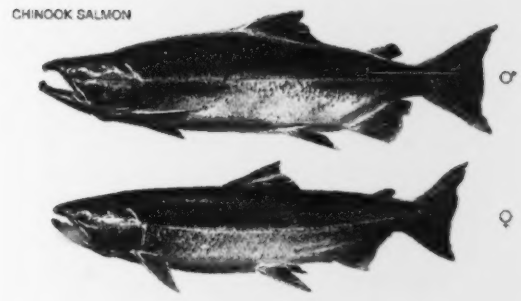
Pacific Region
Canadian Science Advisory Secretariat
Science Advisory Report 2011/015

OPTIMAL PRODUCTION OF CHINOOK SALMON FROM THE TAKU RIVER THROUGH THE 2001 YEAR CLASS



Chinook salmon adult spawning phase. DFO website.

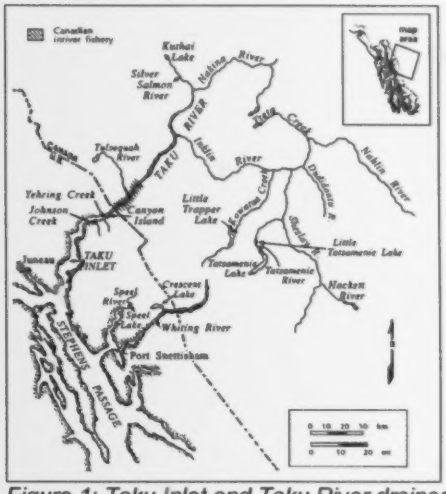


Figure 1: Taku Inlet and Taku River drainage.

Context:

The Taku River is considered a "transboundary" system; one which rises in Canada and flows to the ocean through the United States. Management of salmon originating in the Taku River is through agreements outlined in the Transboundary chapter (Annex IX) of the Pacific Salmon Treaty (PST). Biologically based escapement goals form the basis for management decisions related to transboundary stocks.

The PST Transboundary agreement (2010) commits to establishing updated biologically based escapement goals for the Taku River; and to review of the proposed escapement goals by both the Transboundary technical committee and the Salmon Standing Committee of the Centre for Science Advice Pacific (CSAP).

This Science Advisory Report has resulted from a Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Pacific Regional Advisory Process. Additional publications resulting from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

SUMMARY

- For the purpose of this report, the Taku River Chinook stock was considered a single aggregate population. However, under the Wild Salmon Policy, three Conservation Units have been proposed, consisting of early, middle and late run stocks. Management of Taku River Chinook is conducted bilaterally through the Pacific Salmon Treaty (PST).

Canada

- The Salmon Standing Committee of the Centre for Science Advice Pacific (CSAP) was presented with the results of an updated analysis conducted by the Alaskan Department of Fish and Game (ADF&G) regarding the optimal escapement goal for Taku River Chinook.
- Escapement analysis incorporated stock assessment data from brood years 1973 to 2001, including aerial counts and mark-recapture studies. Data and methods in the current analysis were considered an improvement over methods employed previously.
- Spawning abundance that would produce maximum sustained yield (NMSY) was estimated at 25,075 large Chinook salmon using the traditional Ricker exponential stock-recruit model fit to the production data for the 1983–2001 year classes.
- An escapement goal range of 19,000 to 36,000 large Chinook was recommended in the reviewed report. These escapement ranges represented a 90-98% chance of achieving at least 90% of MSY from these stocks.

BACKGROUND

The Taku River is a relatively large watershed of over 17,000 km^2 that originates in northern British Columbia and drains into Taku Inlet south of Juneau in Southeast Alaska (SEAK) (Figure 1). An estimated 17,094 km^2 or almost all of the drainage, is accessible to anadromous salmon (*Oncorhynchus sp.*). The two main arteries of the Taku River are the Nakina and Inklin rivers. The Inklin drains a larger area and is comprised of several large tributaries that produce salmon, including Chinook salmon (*O. tshawytscha*). Most of the tributaries are clear or slightly occluded by glacial flour, especially in the lower Nakina, Sheslay and Kowatua tributaries.

Chinook salmon from the Taku River are a "spring run" of salmon with adults passing through SEAK from late April through early July on their way to spawn in Canada from late July to mid-September. Almost all juveniles rear for 1 year in the Taku River after emergence. In marine waters, juveniles initially spend time in Taku Inlet for weeks, followed by months of residence in inside coastal areas near Juneau and in Chatham and Icy straits. At least a portion of the population overwinters in these waters. Sometime in the late fall or following summer after leaving Taku River, almost all of a given cohort have reached the outer coast and begin a northwesterly migration along the continental shelf. They spend the remainder of the ocean-rearing portion of their life cycle west and north of SEAK in the Gulf of Alaska and the Bering Sea. Mature adults migrate back through SEAK after 1 to 5 years at sea.

Taku River Chinook salmon have been harvested by aboriginal or native tribal groups from both Canada and Southeast Alaska for centuries, in both the mainstem and in tributaries such as the Nakina River. A commercial fishery for Chinook salmon has operated in Taku Inlet in U.S. waters since the late 1800s. Recreational users have harvested this stock since the early 1900s. Commercial harvests near the terminal area (troll and gillnet) in Taku Inlet averaged 10,000 to 15,000 Chinook salmon from 1900 through 1929 (Kissner 1982). Commercial gillnet harvests appear to have averaged 5,000 or fewer Chinook salmon since that time, except during the 1950s when harvests averaged about 14,000. These figures include harvests for the entire season and include harvests of other stocks. The Taku River Chinook salmon stock undoubtedly contributed substantial numbers to the spring troll fishery in SEAK since the early 1900s, but contribution rates are unknown prior to the late 1970s. Prior to 1976, annual commercial harvests of Chinook salmon from the Taku River were estimated to have reached approximately 15,000 or more, based on spring gillnet and troll harvests in or near Taku Inlet.

Beginning in 1976, commercial fishing for Chinook salmon in SEAK was reduced substantially in terminal areas as part of what subsequently became a coastwide, international rebuilding program under the Pacific Salmon Treaty (PST) signed in 1985. A very conservative management regime remained in place for two decades after the signing of the PST in 1985. In 2005, the U.S. and Canada reached agreement and implemented single-stock management on Taku River Chinook salmon under the Transboundary River portion of the 1999 PST (Transboundary Technical Committee [TTC] 1999). This agreement covered the terminal run, and included the marine recreational fishery near Juneau and marine commercial drift gillnet and troll fisheries in Alaska District 111, as well as commercial gillnet, aboriginal and recreational harvests in Canada. From 1985 to 2007 the average number of Chinook harvested annually was 8,487 with a low of 2,051 fish and a high of 32,103 harvested in 1987 and 2005, respectively.

ANALYSIS

Spawning abundance that would produce maximum sustained yield (NMSY) was estimated at 25,075 large Chinook salmon using the traditional Ricker exponential stock-recruit model fit to the production data for the 1983–2001 year classes, and at 25,686 fit to production data from the 1973–2001 year classes. From simulations of the production data incorporating measurement error from a Bayesian age structured Ricker analysis, a 90% confidence interval of 18,470 to 36,530 around the point estimate of 25,075 above was estimated (Figure 2).

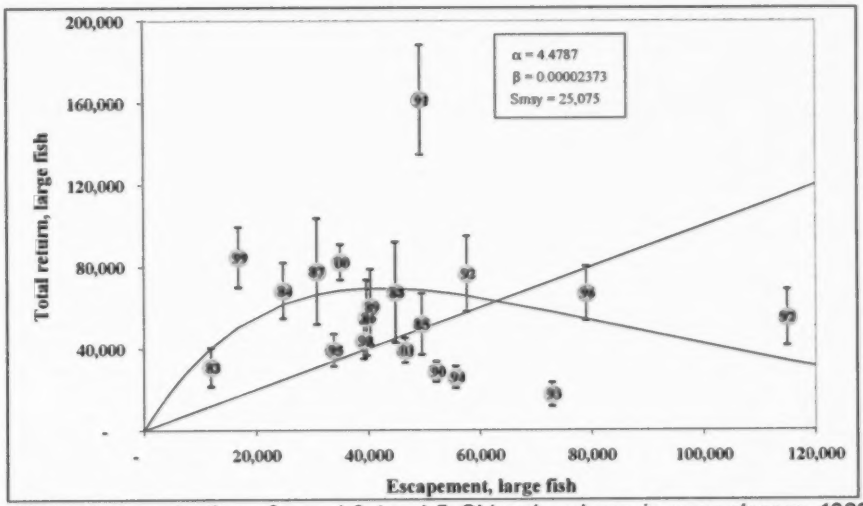


Figure 2. *Estimated production of age-1.3 to -1.5 Chinook salmon in year classes 1983–2001 against the estimated abundance of large spawning Chinook salmon, along with curves corresponding to least-squares fit of the Ricker model and the replacement line.*

No autocorrelation among residuals was detected in fitting these data sets. For the 1983–2001 year classes, the estimated range that will produce, on average, 95% of NMSY is 18,675 to 32,094 large spawners, and that which will produce 90% of NMSY is 16,178 to 35,203 large spawners (Figure 3). Results were corroborated by the Bayesian Markov chain Monte Carlo analysis, a Beverton-Holt model fit to the smolt production data, a Parken habitat model utilizing watershed characteristics, and Ricker models that included smaller, age-1.2 fish.

ADDITIONAL STAKEHOLDER PERSPECTIVES

Data sources, methods and results presented to CSAP and included within the corresponding research document have been previously reviewed and published by the Alaskan Department of Fish and Wildlife.

Methods and data were reviewed and approved by the bilateral CTC in February 2010. The CTC recommended exploring the productivity aspects of the three different CU's within the Taku Chinook aggregate.

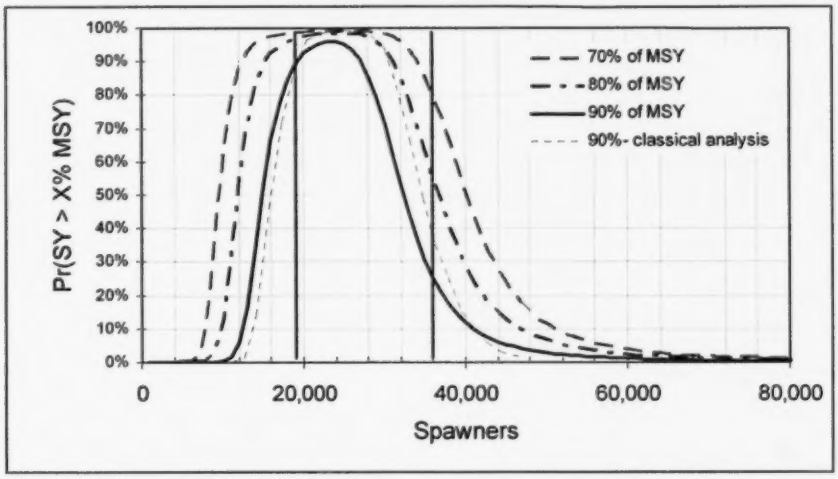


Figure 3. *Probability that a specified spawning abundance will result in sustained yield exceeding 70%, 80%, and 90% of maximum sustained yield, Taku River Chinook salmon (solid lines). The equivalent 90% profile from the classical (non-Bayesian) analysis is shown for comparison as a dashed line. Vertical lines bracket the proposed escapement goal range.*

CONCLUSIONS AND ADVICE

The updated analyses of Taku River River Chinook data were comprehensive and robust in providing both a range and a point estimate for *Smsy* (spawning abundance needed to produce maximum sustained yield) for the Taku River.

The analysis took advantage of a longer time series of catch and escapement data which allowed known sources of uncertainty to be taken into account. The analysis represented an improvement over methods used previously to determine escapement goals for the stock. The calculated *Smsy* value for Taku River Chinook was 25,075 large Chinook with the 90% confidence interval around the point estimate of 18,470 to 36,530.

Results of the analysis are well suited to allow fisheries managers or the Transboundary Technical Committee to make an informed decision about the appropriateness of the escapement ranges presented. While the research document reviewed recommends adopting the yield curve based on an optimal yield that is 90% or better of NMSY, there is no analytical or

biological basis on which to recommend this curve over any other. The choice of which yield curve to use is left to the discretion of Fisheries Management.

SOURCES OF INFORMATION

This Science Advisory Report has resulted from a Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Pacific Regional Advisory Process of October 18-19, 2010 on Assessment of Escapement Goals for Alsek River Chinook and Sockeye and Taku River Chinook and Coho. Additional publications resulting from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

McPherson, S.A., E. L. Jones III, S. J. Fleischman, and I. M. Boyce. 2010. Optimal Production of Chinook Salmon from the Taku River Through the 2001 Year Class. Alaska Department of Fish and Game, Fishery Manuscript Series No. 10-03, Anchorage. http://www.adfg.alaska.gov/FedAidPDFs/FMS10-03.pdf

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